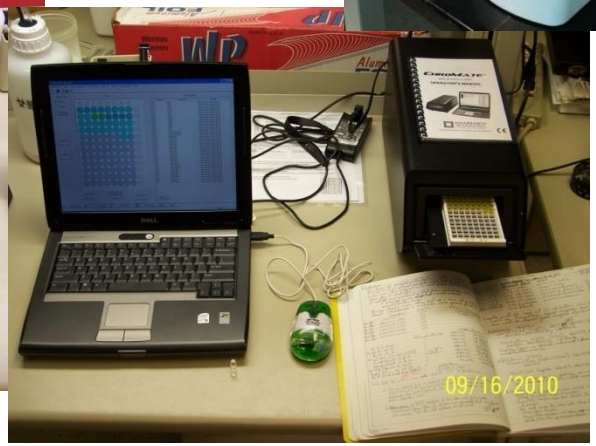
Indiana's Cyanobacteria Monitoring Program

Cyndi Wagner, Chief
Targeted Monitoring Section
Watershed Assessment and
Planning Branch

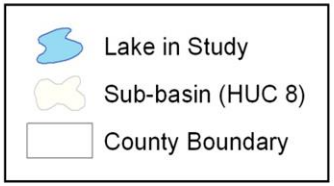
IDEM's Pilot Cyanobacteria Monitoring Program 2010-2011

- Funded by a Supplemental 106 Grant
- Two-year funding cycle
- June through late August
  - Five lakes in 2010
  - Eleven in 2011
- Partnered with IUPUI Center for Earth and Environmental Science (CEES)

Cyanobacteria Collection and Analysis Process



2014 Cyanobacteria Lake Sampling



Department of Natural Resources Properties State Parks (SP) and Recreation Areas (RA)

Potato Creek SP – Worster Lake
Pokagon SP – Lake James.
Chain O'Lakes SP – Sand Lake
Salamonie Lake– Lost Bridge West RA
Mississinewa Lake – Miami RA
Cecil Harden (Racoon Lake) – Raccoon RA
Lake Monroe – Fairfax and Paynetown RAs
Hardy Lake RA – Hardy Lake
Whitewater Memorial SP – Whitewater Lake
Brookville Lake – Quakertown and Mounds RAs
Deam Lake RA – Deam Lake
Starve Hollow RA – Starve Hollow Lake
Lincoln SP – Lincoln Lake
Ferdinand State Forest – Ferdinand Lake

Mapped By: MYRA MCSHANE, OWQ
Date: June 6, 2013

Worster Lake at Potato Creek State Park
Planktothrix agardhii bloom July 4th, 2013

Storm water retention pond, Marion County
Microcystis bloom September 13th, 2013

Lake Shipshewana
Anabaena spiroides and Aphanizomenon flos-aquae

Dogs and Cyanobacteria

- Dogs prefer cyanobacteria-laden water to clean water
- **Up to 90% of a lethal dose of toxin may elicit no clinical signs**
- Symptoms present within minutes to hours
- Death can occur within hours
- No reliable antidotes
- Seek veterinary care IMMEDIATELY
  - Tell the vet you suspect blue-green algae

Video | Photo

Share | Expand

- Toxic algae found in five Indiana lakes

Dogs die after swimming in Salamonie Reservoir

Updated: Friday, 20 Jul 2012, 12:04 PM EDT
Published : Wednesday, 18 Jul 2012, 7:13 PM EDT

Adam Widener

ANDREWS, Ind. (WANE)--What began as playtime with the pets turned fatal at the Salamonie Reservoir Sunday. A couple from Wabash was playing fetch with four dogs in the water. 24-hours later, two of those animals were dead. The couple is blaming high levels of blue-green algae.

Salamonie Reservoir is a place Larry and Marge Young frequently play with their dogs. But Sunday's good time suddenly took a turn for the worse for their three dogs and their daughter's Labrador.

"Within two hours one of them was deathly ill and was dead within 12 or 14 hours," Larry Young said. "The second died within 24 hours."

Friday Update: As of Friday morning, Marge Young said the two other dogs seemed to be doing better and acting as though back to normal. She thinks they may have liver damage but believes they will make a full recovery.

The reason wasn't clear to the Youngs at the time, but they think the killer was a toxic blue-green algae hiding in the water. The Youngs said their vet told them blue-green

COMMON FRESHWATER CYANOBACTERIA

ORDER: CHOROOCCOCALES Unicellular to spheroid colonies				
GENUS/SPECIES	**OTHER TOXIN[1]**	**HEPATOTOXIN**	**NEUROTOXIN**	**TASTE/ODOR COMPOUND**
Aphanacapsa spp.	Lipopolysaccharide	Microcystins		
Microcystis spp.	Lipopolysaccharide	Microcystins	Anatoxins	
Snowella spp	Lipopolysaccharide	Microcystins		
Synechococcus spp.	Lipopolysaccharide	Microcystins		[2] MIB, Geosmin
Woronichinia spp.	Lipopolysaccharide	Microcystins		
Merismopedia spp.	Lipopolysaccharide	Microcystins		
Synechocystis spp.	Lipopolysaccharide	Microcystins	[3]BMAA	
Aphanothece	Lipopolysaccharide			
Chroococcus	Lipopolysaccharide			
Coelosphaerium	Lipopolysaccharide	Microcystins		

ORDER: OSCILLATORIALES Filamentous, NO Heterocysts or Akinetes					
GENUS/SPECIES	**OTHER TOXIN**	**IRRITANT TOXIN**	**HEPATOTOXIN**	**NEUROTOXIN**	**TASTE/ODOR COMPOUND**
Lyngbya spp.	Lipopolysaccharide	Lyngbyatoxin		Saxitoxins	MIB
Oscillatoria spp.	Lipopolysaccharide	Aplysiatoxin	Microcystins	Anatoxins, Saxitoxins	MIB, Geosmin
Planktothrix agardhii	Lipopolysaccharide	Aplysiatoxin	Microcystins	Saxitoxins	MIB, Geosmin
Pseudanabaena spp.	Lipopolysaccharide			Anatoxins	MIB, Geosmin
Planktolyngbya spp.	Lipopolysaccharide	Lyngbyatoxin		Saxitoxins	MIB, Geosmin

ORDER: NOSTOCALES Filamentous WITH Heterocysts and Akinetes (Nitrogen Fixers), no true branching				
GENUS/SPECIES	**OTHER TOXIN**	**HEPATOTOXIN**	**NEUROTOXIN**	**TASTE/ODOR COMPOUND**
Dolichospermum (formerly Anabaena) spp.	Lipopolysaccharide	Microcystins, [4]Cylindrospermopsin	Anatoxins, Saxitoxins, BMAA	MIB, Geosmin
Anabaenopsis elenkii	Lipopolysaccharide	Microcystins		
Aphanizomenon spp. [5] *A. flos-aquae NOT a toxin producer*	Lipopolysaccharide	Microcystins, Cylindrospermopsin	Anatoxins, Saxitoxins, BMAA	Geosmin
[6]*Cylindrospermopsis raciborskii*	Lipopolysaccharide	Cylindrospermopsin	Saxitoxins, BMAA	
[6] *Raphidiopsis curvata*	Lipopolysaccharide	Cylindrospermopsin	Anatoxins	

[1] All gram negative bacteria produce Lipopolysaccharides. Much controversy about whether the type of Lipopolysaccharide produced by cyanobacteria is that toxic. LPS can cause gastrointestinal distress, skin rashes, respiratory and allergic reactions based on other pathogenic gram negative bacteria. *Cyanobacterial lipopolysaccharides and human health – a review Ian Stewart123, Philip J Schluter4 and Glen R Shaw135 Environmental Health: A Global Access Science Source 2006, 5:7 doi:10.1186/1476-069X-5-7*

[2] Methylisoborneol

[3] Beta-methyl-amino-alanine

[4] Also a general cytotoxin

[5] Wayne Carmichael, PhD, professor emeritus Wright State University; David Farrer, PhD, Oregon Office of Public Health and Jacob Kann, PhD, Aquatic Ecosystem Sciences LLC

[6] *C. raciborskii* and *R. curvata* are tropical species currently thriving in Indiana lakes as the water temperature rises to 30 C (86F). *Raphidiopsis* does not seem to develop heterocysts.

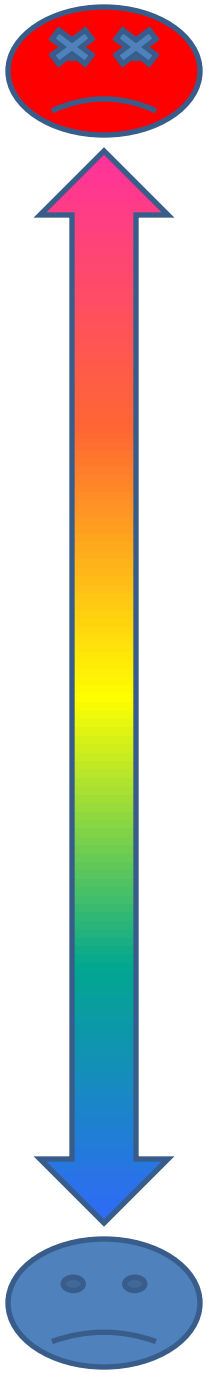
Some of the More Important Cyanotoxins and Their Effects on Non-target Organs

Microcystins	Liver	Tumor Promoter
Nodularins	Liver	Carcinogenic
Cylinderospermopsin	Liver	Genotoxic
Anatoxin *a*	Nervous System	Depolarizing neuromuscular blockers
Anatoxin *a* (s)	Nervous System	Inhibits AchE
Saxitoxin	Nervous System	Na+ channel blocker
BMAA	Nervous System	Neurodegeneration
Lyngbyatoxin *a*	Skin	Inflammatory agent
Aplysiatoxins	Skin	Inflammatory agent
Lipopolysaccharide	Gastrointestinal Tract	Gastrointestinal irritant

Co-occurrence of the Cyanotoxins BMAA, DABA and Anatoxin-*a in Nebraska Reservoirs, Fish, and Aquatic Plants*
Maitham Ahmed Al-Sammak 1,3, Kyle D. Hoagland 2, David Cassada 3 and Daniel D. Snow 3, *Toxins 2014, 6, 488-508; doi:10.3390/toxins6020488*

Toxicity of Algal Toxins Relative to Other Toxic Compounds Found in Water

- Reference Dose = amount that can be ingested orally by a person, above which a toxic effect may occur, on a milligram per kilogram body weight per day basis.



Toxin Reference Doses

- Dioxin (0.000001 mg/kg-d
- **Microcystin LR** (0.000003 mg/kg-d)
- Saxitoxin (0.000005 mg/kg-d)
- PCBs (0.00002 mg/kg-d)
- **Cylindrospermopsin** (0.00003 mg/kg-d)
- Methylmercury (0.0001 mg/kg-d)
- **Anatoxin-A** (0.0005 mg/kg-d)
- DDT (0.0005 mg/kg-d)
- Selenium (0.005 mg/kg-d)
- Botulinum toxin A (0.001 mg/kg-d)
- Alachlor (0.01 mg/kg-d)
- Cyanide (0.02 mg/kg-d)
- Atrazine (0.04 mg/kg-d)
- Fluoride (0.06 mg/kg-d)
- Chlorine (0.1 mg/kg-d)
- Aluminum (1 mg/kg-d)
- Ethylene Glycol (2 mg/kg-d)

Slide Courtesy Linda Merchant–Masonbrink Ohio EPA

World Health Organization Guidance Values

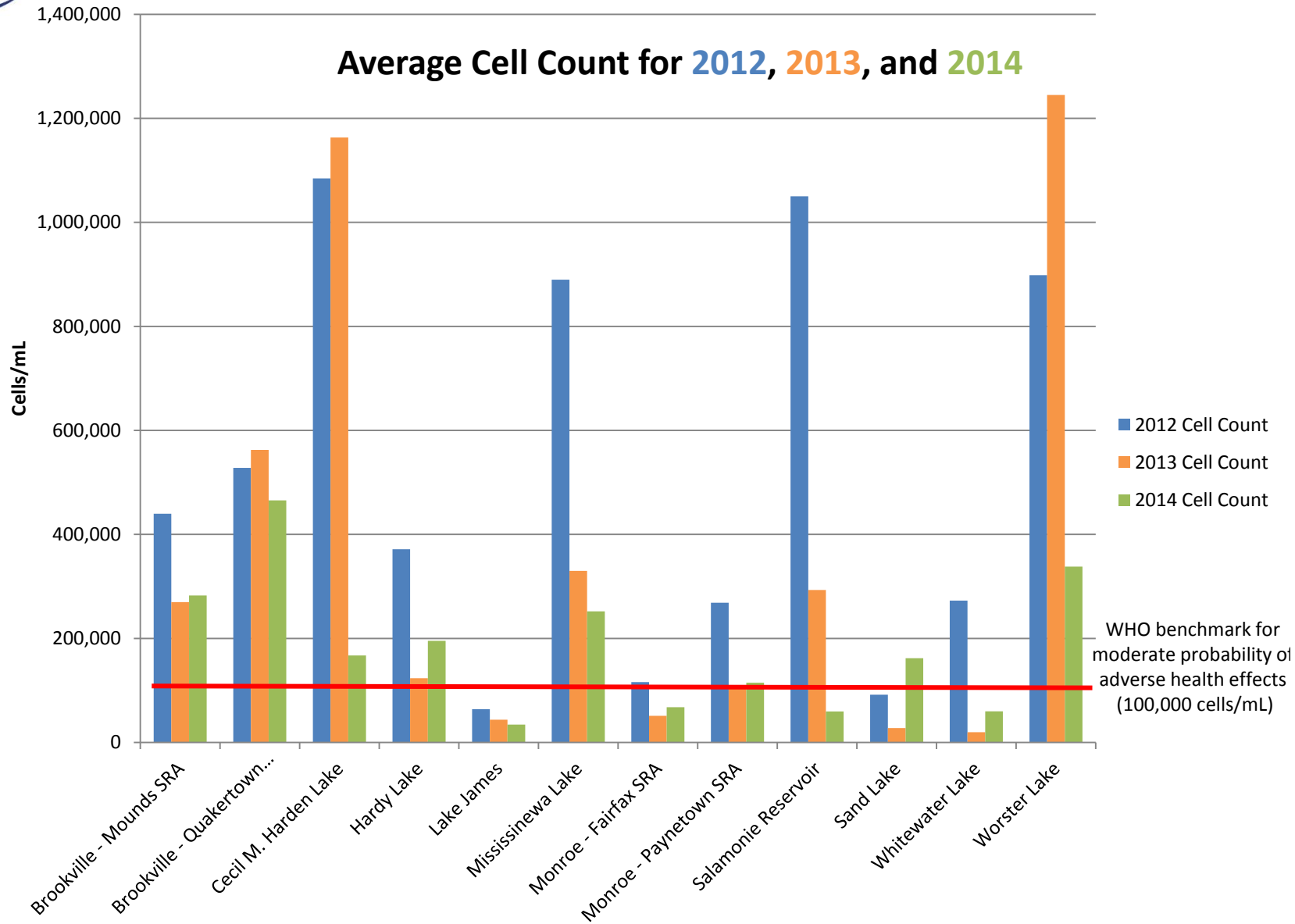
Relative Probability of Acute Health Affects	Cyanobacteria Cells/ml	Microcystin-LR µ/L	Action
Low	<20,000	**<10**	Post Advisory Signs
Moderate	20,000-**100,000**	10-20	Post Advisory Signs and Restrict Swimming
High	100,000-10,000,000	20-2,000	Post Advisory Signs, Prohibit Swimming and Other Water Contact Activities
Very High	>10,000,000	>2,000	

Cylindrospermopsis

Cell Count Summary

Recreation Advisory Issued at 100,000 Cells

Year Sampled	2014	2013	2012	2011	2010
# Lakes	14	12	10	10	5
# Samples	81	63	70	58	18
Highest Cell Count	935,000	3.3 million	1.8 million	798,000	260,000
% Over 100,000	37.5	57	76	48	28
% Over 1 million	0	11	16	0	0


Average Cell Count for 2012, 2013, and 2014
Cells/mL
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Brookville - Mounds SRA
Brookville - Quakertown...
Cecil M. Harden Lake
Hardy Lake
Lake James
Mississinewa Lake
Monroe - Fairfax SRA
Monroe - Paynetown SRA
Salamonie Reservoir
Sand Lake
Whitewater Lake
Worster Lake
2012 Cell Count
2013 Cell Count
2014 Cell Count
WHO benchmark for moderate probability of adverse health effects (100,000 cells/mL)

Cylindrospermopsis

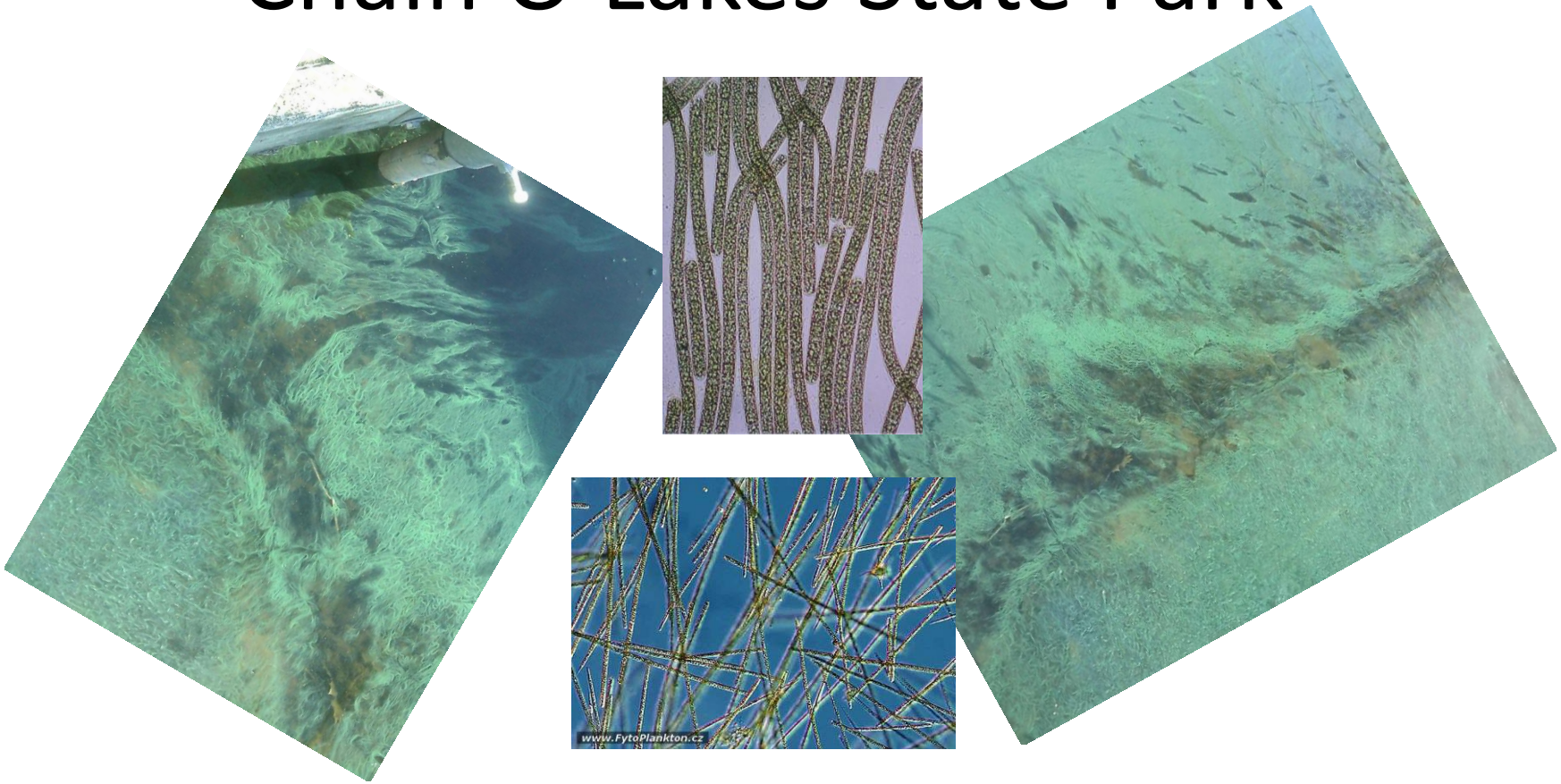
Microcystin Toxin Summary

Sensitive Population Warning Level 6 ppb

Beach Closure at 20 ppb

Year Sampled	2014	2013	2012
% Detections	33	30	44
Highest concentration	1.8 ppb	2.8 ppb	4.3 ppb

Long Lake
Chain O'Lakes State Park



Planktothrix agardhii bloom, November 28, 2010
Microcystin toxin a record 367 ppb

Reporting to the Public

- www.algae.IN.gov
  - Provide public with information about:
    - Weekly lake sampling results
    - Precautionary advisories
    - Risks associated with toxins
    - Precautions you can take
    - Links to other websites
- www.dnr.in.gov
  - Advisory information posted on the property link
- http://www.in.gov/boah/2617.htm
  - Information for pets and livestock owners

Addressing Concerns About Blue-Green Algae

Blue-Green Algae Home

- About Blue-Green Algae
- Newsroom
- Resources
- Test Results
- Contact Us

Visit the IDEM Website

Welcome

The Indiana Department of Environmental Management (IDEM), the Indiana Department of Natural Resources (DNR), the Indiana State Department of Health (ISDH), and the Board of Animal Health (BOAH) are working to provide information about blue-green algae, also known as cyanobacteria, in our lakes.

Algae are commonly found in Indiana lakes and streams without concern, however the concentrated presence of blue-green algae can be linked to some adverse health effects. Factors promoting algal growth include sunlight, warm weather, low turbulence, and nutrient sources, such as phosphorus and nitrogen. Phosphorous is particularly important in fueling cyanobacteria growth. Often nutrient inputs come from nonpoint source pollution, but fortunately, there are many ways to reduce or stop nonpoint source pollution, many of which are simple things we can do right in our own backyards.

This website will be updated weekly during the sampling season to provide information about blue-green algae levels at the DNR lakes that IDEM samples and the Citizen Energy reservoirs in central Indiana. The IDEM video, Sampling Blue-green Algae, explains how IDEM staff samples the DNR swimming beaches.

Online Services

- Virtual File Cabinet
- Real-Time Monitoring
- Publication Catalog
- Wastewater Certification Renewal
- Acronyms List
- Online Air Permit Search
- Enforcement Database
- Safe Drinking Water Information Search
- Forms.IN.gov

MORE ONLINE SERVICES »

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Top FAQs I Want To...

1. How do I file an IDEM complaint?
2. I'm interested in internship/employment opportunities working with environmental issues. How do I apply and what jobs are available?
3. How do I get rid of electronic waste?
4. What should I do with my old computers and electronics?
5. Where can I find information about available IDEM grants, loans, or funds?
6. What is "household hazardous waste"?

Indiana Reservoir and Lake Update

July 24, 2014

IDEM began blue-green algae sampling the week of May 12th and will end the week of August 29th. IDEM samples for blue-green algae and analyzes those samples for the type and quantity of blue-green algae present and for the following toxins which may be produced by certain types of blue-green algae: microcystin, cylindrospermopsin (only done if species that produce it are present) and anatoxin-a. For protection of human health from exposure to the algae and any of the toxins, Indiana will use the World Health Organization (WHO) guideline level of 100,000 cells/ml or a microcystin toxin level of 6 parts per billion (ppb) for a Recreation Advisory. Beaches will be closed if microcystin toxin reaches 20 ppb. The WHO has not set guideline values for cylindrospermopsin or anatoxin-a. Indiana will use 5 ppb of cylindrospermopsin and 80 ppb of anatoxin-a for a Recreation Advisory, consistent with the state of Ohio recommendations. Toxin results will be posted if they meet those threshold numbers. Exact cell counts and toxin levels can be found in the Test Results section of the web site. Swimming areas will stay on the High Cell Count Alert until the cell counts fall below 100,000.

The following swimming beaches will be sampled monthly unless cell counts are at 100,000 or greater, at which point sampling will be done biweekly until counts fall below 100,000.

IDEM Sampling Results - High Cell Count Recreation Alert

- Brookville Lake - Mounds State Recreation Area
- Brookville Lake - Quakertown State Recreation Area
- Chain O'Lakes State Park - Sand Lake
- Hardy Lake - Hardy Lake State Recreation Area
- Potato Creek State Park - Worster Lake
- Salamonie Lake - Lost Bridge West State Recreation Area

IDEM Sampling Schedule

July 7th, 2014

- Monroe Lake - Fairfax State Recreation Area
- Monroe Lake - Paynetown State Recreation Area

State Parks & Reservoirs > Parks & Reservoirs > Potato Creek State Park

DNR HOME

STATE PARKS & RESERVOIRS

- About Us
- Contact Us
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- Rates & Fees
- Rules & Regulations
- Publications

STEWARDSHIP LINKS

- Interpretation
- Programs
- Interpretive Centers
- Science and Natural Resources
- Brochures
- Cultural Resources & History
- How You Can Help
- Just For Kids
- Indiana State Parks Centennial Celebration

POTATO CREEK STATE PARK

Mailing Address:
P.O. Box 908
North Liberty, IN 46554
(574) 656-8186
Mapping Address:
25601 State Road 4
North Liberty, IN 46554

North Liberty, IN
82 °F / 28 °C
Clear
at 11:58 AM
Click for Forecast

- Property Advisories
- **Blue-Green Algae ADVISORY at Potato Creek State Park**: Swimming and boating is permitted.* Avoid direct contact with algae. Don't drink the water. Shower after you swim. Keep pets out of the water or, at minimum, bathe them after swimming, and prevent them from licking algae/water from fur. For more information, visit http://www.algae.in.gov/ or read our FAQ sheet. This notice will be removed when blue-green algae levels drop.
- **THE DOG BEACH AT POTATO CREEK IS CURRENTLY CLOSED.**

Online Services

- Reserve A Campsite
- Buy A State Park Permit
- Reserve Room at State Park Inn
- Buy a Horse Permit
- Buy a Boating Permit

MORE ONLINE SERVICES »
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Top FAQs | I Want To...

1. Find Out the Cost to Visit a State Park
2. Find a Map for a State Park
3. View Upcoming Nature Programs
4. Place a Geocache
5. Sponsor Registration for Fishing Tournaments

Does the Beach Have Blue-green Algae?

Blue-green algae can be found in many of Indiana's lakes and reservoirs. Swimmers, boaters and pet owners can enjoy water based recreation, but should be on the lookout for evidence of harmful algal blooms (HABs).

Blue-Green Algae

Algae of many species occur naturally in Indiana's lakes and reservoirs. Blue-green algae is common and not a problem unless levels are high. When levels are high, toxins may be produced as algae cells grow and die.

How Can Exposure to High Levels of Blue-Green Algae Affect People, Pets and Fish?

Swimmers and boaters

Precautions:
Avoid contact with algae.

Avoid swallowing water while swimming.

Take a bath or shower with warm, soapy water after coming in contact with lake water.

Do not use lake water for cooking or bathing.

Pet Owners

Pets can be poisoned by the toxins produced by some algae.

Precautions:
Do not allow your pets to swim in or drink water where algae is present.

Rinse pets with soap and water if they swim in murky water.

Do not let your pet lick algae off their fur.

Fishing

Some toxins may accumulate in the tissues of fish.

Precautions:
Do not cut into organs when filleting your fish.

Rinse the fillets with clean water before freezing or cooking.

Avoid consuming the guts, where toxin accumulation is greatest.

Eat in moderation.

What Does Blue-Green Algae Look Like?

When conditions are right, HABs may occur. An HAB occurs when algae reproduce quickly, creating mats of algae or discoloration of the water because of the large quantity of algae cells present. High nutrient levels from lawn and agricultural fertilizers, sunlight and warm, shallow water all contribute to HABs.

Colors may vary from green, blue-green, brown, black, white, purple, red or black.

Algae may look like a film, crust, puff balls, grass clippings, dots, spilled paint, pea soup, foam, wool, streaks or cottage cheese curds.

Watch for signs that might indicate a blue-green algae bloom in this lake or reservoir and report your sighting to the property office.

Photos courtesy of the Indiana Department of Environmental Management.

Blue-green algae and toxin levels are tested in this body of water. Alert levels vary with testing results:

LOW RISK
Don't drink the water
Shower after you swim

ADVISORY
Swimming and boating permitted.

Avoid contact with algae.

Avoid swallowing water while swimming.

Take a bath or shower with warm soapy water after coming in contact with lake water.

Do not use lake water for cooking or bathing.

Do not allow your pets to swim in or drink water where algae are present.

CAUTION
All Recreation Advisory precautions, plus . . .
Children and those with compromised immune systems should not swim.

BEACH CLOSED
Algae and toxin levels make this beach currently unsafe for swimming.

Today's Alert Level

ADVISORY
Don't drink the water. Shower after you swim. Keep pets out of the water.

Indiana's lakes and reservoirs provide great recreational opportunities. Learn to recognize blue-green algae, be alert, take precautions and have fun on the water!

US Army Corps of Engineers

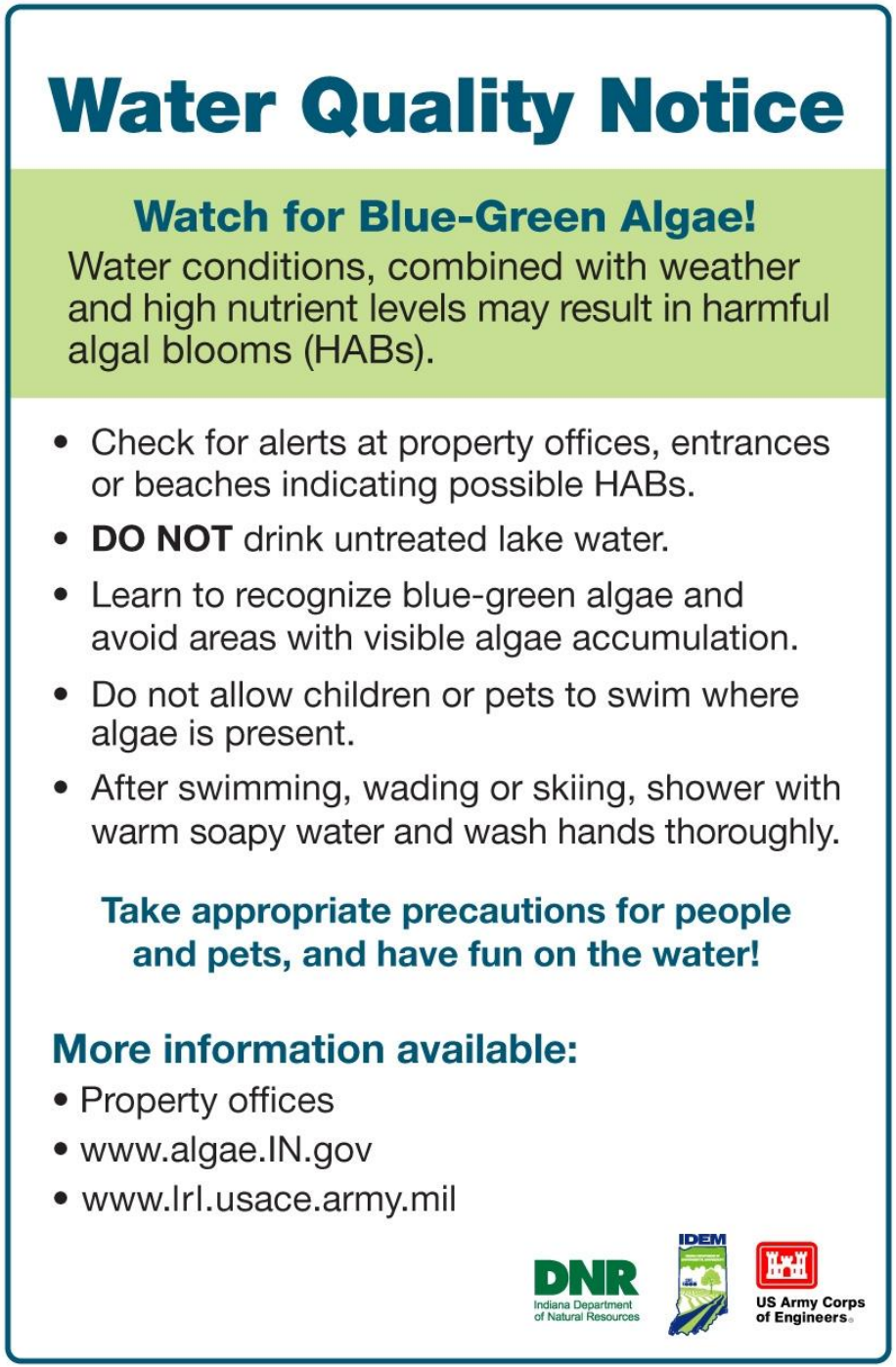
IDEM

INDIANA STATE PARKS RESERVOIRS

DNR
Indiana Department of Natural Resources

Photos courtesy of IDEM and DNR

Signs at Other DNR Lake Access Points



Water Quality Notice

Watch for Blue-Green Algae!

Water conditions, combined with weather and high nutrient levels may result in harmful algal blooms (HABs).

- Check for alerts at property offices, entrances or beaches indicating possible HABs.
- **DO NOT** drink untreated lake water.
- Learn to recognize blue-green algae and avoid areas with visible algae accumulation.
- Do not allow children or pets to swim where algae is present.
- After swimming, wading or skiing, shower with warm soapy water and wash hands thoroughly.

Take appropriate precautions for people and pets, and have fun on the water!

More information available:

- Property offices
- www.algae.IN.gov
- www.lrl.usace.army.mil

DNR Indiana Department of Natural Resources

IDEM

US Army Corps of Engineers

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- Animal Health Emergencies
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- Livestock and Poultry Care
- Commercial Dog Breeder & Broker

BLUE-GREEN ALGAE

With summer approaching, BOAH veterinarians advise animal owners to learn more about blue-green algae, often called "pond scum." The algae is a health concern for both people and animals. The algae grows best on hot, dry, calm days, just like our summers here in Indiana.

Veterinarians are asked to report incidents of blue-green algae exposure in animals. Form 55580 should be submitted to BOAH as part of a statewide blue-green algae surveillance program.

WHAT IS BLUE-GREEN ALGAE?

Blue-green algae, also known as cyanobacteria, is a microscopic bacteria found in freshwater lakes, streams and ponds where water is warm and stagnant. Most people refer to the algae as "pond scum."

WHAT'S SO BAD ABOUT BLUE-GREEN ALGAE?

It's poisonous. While some types of algae are harmless, the blue-green type produces a natural powerful toxin. Some form toxins that affect the nervous system and others produce toxins that affect the liver.

Livestock, pets and wild animals can be poisoned by the toxins produced by some algal blooms. Lighter weight animals can ingest a toxic dose quickly. Dogs are particularly susceptible to blue-green algae poisoning because the scum can attach to their coats and be swallowed during self-cleaning.

WHAT DOES THE ALGAE LOOK LIKE?

Blooms look like green paint floating on water, foam or scum, or mats on the surface of freshwater lakes and ponds. The blooms can be blue, bright green, brown or red. Some

Online Services
- New BOAH Rules
- Online Permit Request
- Scrapie Ear Tag Order Form
- Forms.IN.gov

MORE ONLINE SERVICES »

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Top FAQs | I Want To...

1. Where can I find a list of Indiana state animal-related laws?
2. What are the requirements for moving animals in and out of Indiana?
3. What do I need to do to bring my pet to Indiana?
4. How do I report animal abuse or neglect?
5. How do obtain scrapie tags?

More FAQs»

Posters Distributed to Veterinarians

Contact

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